Fruit Varieties Journal 42(2):45-48 1988

American Pomological Society U.P. Hedrick Award for research paper by a student: (1987 Second Place Award)

The Importance of Growth During Flower Bud Differentiation to Maximizing Yield in Strawberry Genotypes

BERNADINE C. STRIK AND JOHN T. A. PROCTOR[1]

Abstract

Vegetative growth of 12 strawberry genotypes (*Fragaria* x *ananassa* Duch.) was measured during flower bud differentiation in the establishment year. Plants were grown in ribbon rows with 8 plants per genotype harvested weekly from 12 Aug. to 23 Sept. 1985. Genotypes differed in the mean number of crowns, crown dry weight, number of leaves, leaf dry weight, leaf area, number of stolons, average stolon length and runner dry weight per plant. The mean crown dry weight, leaf dry weight and leaf area per plant were correlated with yield per plant among genotypes in 1986. These growth variables may be useful for primary screening for high yield in breeding programs and suggest that growth should be optimized in the fall to maximize fruit yield.

Additional Index Words. Fragaria x *ananassa*, establishment year, runners.

Introduction

The continual interest in producing higher-yielding cultivars has stimulated interest in the physiological factors contributing to final yield and in the possibilities of selecting these factors in breeding programs. Various plant characteristics have been found associated with yield in strawberry (2, 3, 5, 6, 11, 12).

Flower bud differentiation in strawberry occurs in the late summer and fall the year prior to fruiting (7, 9). Sproat *et al.* (12) suggested that large variations in yield potential can arise during flower bud differentiation.

The purpose of this study was to determine whether yield among strawberry genotypes is correlated with vegetative growth during flower bud differentiation.

Materials and Methods

Twelve genotypes were selected because of observed differences in growth pattern and yield (Table 1). Planting occurred 7 May 1985 on a typic hapludalf (Fox sandy loam) at the Cambridge Research Station, University of Guelph. Plants were set 30 cm apart within the row with 120 cm between rows, in a ribbon row system. Water was supplied by trickle irrigation and fertilizer, pesticides, and herbicides were applied as required according to standard commercial practices (1). Plants were deblossomed according to standard commercial practices. Eight mother plants, including any formed daughter plants, were dug for each genotype weekly from 12 Aug. to 23 Sept. 1985. Plants were separated into crowns, petioles, leaf laminae and stolons. The numbers of crowns, leaves and stolons were obtained. The average length from the mother plant to the first daughter plant (second node) on the runner "string" was obtained for each plant. Leaf area was determined using a LI-3000 Area Meter (Lambda Instruments Corporation, Lincoln, Neb.) fitted with a LI-3050A transparent belt accessory. All plant parts were dried at 70°C to a constant weight.

In 1986 yield per plant was obtained from 10 plants, for each genotype, grown in ribbon rows. Yield per 2 m section of matted row was also obtained for each genotype.

[1]Graduate student and Professor respectively, Department of Horticultural Science, University of Guelph, Guelph, Ontario, N1G 2W1, Canada.

All the plant characters measured were averaged from 12 Aug. to 23 Sept. Data were analysed by analysis of variance and means compared with Duncan's multiple range test (DMRT). Correlation analyses were performed between the mean values and yield per plant and per section of matted row among genotypes in 1986.

Results and Discussion

The twelve genotypes differed in plant growth during flower bud differentiation (Table 2). 'Redcoat' and 'Bounty' had the greatest mean number of crowns per plant, and 83T6, 10G26 and 71M59 had the fewest. 'Redcoat' had a greater number of leaves, leaf dry weight and leaf area per plant than the other genotypes. 'Veeglow,' 83T6, and 71M59 were the least vigorous in terms of leaf number and leaf area (Table 2). Yield per plant among genotypes in 1986 (Table 1) was correlated with mean crown dry weight per plant, leaf area and leaf dry weight per plant during flower bud differentiation in the fall of 1985 (Table 3). The importance of these plant characteristics to yield variability could be due to the number of available axillary buds for inflorescence initiation. Leaf area would also be important if differences in photosynthesis among genotypes were related to yield (10). Yield per section of matted row was not correlated with any of the plant variables measured (Table 3).

Table 1. Fruit yield data for 1986 of twelve strawberry genotypes studied during the establishment year, 1985, and the fruiting season, 1986.

Genotype	Yield (kg/2m plot)	Yield/Plant (g)
94L12[z]	5.8 ± 0.4[y]	968.49 a[x]
Bounty	5.2 ± 1.2	931.62 a
Veestar	7.9 ± 1.1	912.08 a
62E55	8.4 ± 0.0	902.26 a
83T6	6.7 ± 1.3	812.68 ab
Redcoat	5.7 ± 0.1	696.44 bc
Veeglow	5.0 ± 0.1	600.89 cd
10G26	4.2 ± 0.9	561.70 cd
42V42	4.4 ± 0.8	512.93 de
Vibrant	5.2 ± 0.7	499.82 de
71M59	——	360.13 ef
132E57	6.7 ± 1.3	251.21 f

[z]Selections came from a breeding program developed by Dr. W. D. Evans, University of Guelph.
[y]Mean ± standard error (M = 3). No data were collected for 71M59.
[x]Means followed by the same letter are not significantly different. ($P \leq 0.05$), DMRT (N = 9).

Table 2. Mean values per plant of growth variables during the establishment year (8 Aug to 23 Sept 1985) for twelve strawberry genotypes.

Genotype	Crown no.	Crown dry wt. (g)	Leaf no.	Leaf dry wt. (g)	Leaf Area (cm^2)
94L12	2.5bc[z]	2.56abc	16.6bc	12.04cd	1179.7c
Bounty	2.8ab	2.4bc	16.0bc	15.41b	1416.7b
Veestar	2.4cd	2.76ab	17.8b	14.94b	1321.1bc
62E55	2.4cd	2.24cd	15.9bc	12.49c	1257.8c
83T6	1.6f	1.35g	12.0ef	7.05fg	640.6gh
Redcoat	2.8ab	2.79a	23.6a	17.58a	1705.2a
Veeglow	2.0e	1.82ef	12.4ef	9.13e	734.3fg
10G26	1.3f	1.89ef	11.2f	8.89e	903.6de
42V42	2.3cde	1.98de	13.8de	10.73d	1035.9d
Vibrant	2.4cd	2.00de	16.6bc	11.02d	996.3d
71M59	1.4f	1.40g	8.4g	5.81g	535.0h
132E57	2.0de	1.62fg	14.8cd	8.36ef	791.8ef

[z]Means followed by the same letter within columns are not significantly different, ($P \leq 0.05$), DMRT. (N =45).

Table 3. Correlation coefficients between mean values of growth variables during the establishment year (8 Aug to 23 Sept 1985) and yield per plant (g) and yield per 2 m section of matted row (kg/plot) among genotypes in 1986.

	C[z]	CDW	L	LDW	LA	TS	TRDW	Y/Pl.
C								
CDW	.82**[y]							
L	.85***	.84***						
LDW	.88***	.95***	.90***					
LA	.85***	.95***	.89***	.98***				
TS	.35	.42	.49	.50	.56			
TRDW	.29	.44	.61*	.54	.58*	.70*		
Y/Pl.	.50	.62*	.40	.58*	.57*	.10	.29	
Y/row	.18	.17	.26	.17	.16	.52	.53	.36

[z]Abbreviations are as follows: C: Number of crowns; CDW: Crown dry weight; L: Number of leaves; LDW: Leaf dry weight; LA: Leaf area; TS: Total number of stolons on last week of harvest; TRDW: Total runner dry weight; Y/Pl.: Yield per plant; Y/row: Yield per 2 m section of matted row.
[y]Asterisks below the correlation coefficient indicate significance at: $P \leq 0.05$ (*); $P \leq 0.01$ (**); and $P \leq 0.001$ (***). N = 12.

'Veeglow' and 71M59 had the fewest number of stolons developed per plant (Table 4). 'Veestar,' 'Redcoat,' and 132E57 tended to have a greater number of stolons. 'Veestar' and 'Redcoat' had a greater runner dry weight than the other genotypes (Table 4). Runners accounted for more than 50% of total plant dry weight in all genotypes except 94L12 and 'Bounty' (data not shown). Developing runners would be expected to place a stress on the mother plant when the runners are unable to supply their own water and nutrient needs (4). The distance between the mother plant and the first formed daughter plant on the runner "string" may be important in affecting plant density within the matted row. The average stolon length varied among genotypes and was greatest in 'Redcoat' and smallest in 'Vibrant' and 71M59 (Table 4). However, the number of stolons, runner dry weight and the average stolon length were not correlated with yield per plant or yield per section of matted row (Table 3).

Table 4. The number of stolons, average stolon length and runner dry weight per plant of twelve strawberry genotypes during the establishment year, 1985.

Genotype	No. Stolons	Average Stolon Length (cm)[z]	Runner dry wt. (g)
94L12	8.0 e[y]	28.9 d	24.36 bcd
Bounty	9.2 cde	22.5 f	19.06 d
Veestar	13.0 a	30.6 bcd	42.30 a
62E55	9.1 cde	30.2 cd	32.97 b
83T6	9.3 cde	24.9 e	24.61 bcd
Redcoat	12.1 ab	33.7 a	41.76 a
Veeglow	6.4 f	29.1 d	18.15 d
10G26	10.1 cd	31.4 bc	31.85 bc
42V42	10.6 bc	32.0 b	21.44 d
Vibrant	8.6 de	22.8 f	22.90 cd
71M59	5.8 f	22.3 f	19.30 d
132E57	11.7 ab	30.1 cd	27.01 bcd

[z]Mean length from mother plant to first daughter plant on each runner "string."
[y]Means followed by the same letter within columns are not significantly different, ($P \leq 0.05$), DMRT. (N = 45).

The growth variables, crown dry weight or size and leaf area may be useful for primary screening for high yield in breeding programs. As potential yield in strawberry is determined during flower bud differentiation and various growth variables were found to be related to yield per plant, growing conditions should be optimized in the fall to maximize yield. This may involve renovating (mowing off the foliage and fertilizing) as soon after fruit harvest as possible, increasing soil fertility levels, and runner removal or thinning.

Literature Cited

1. Anonymous. 1984. Fruit Production Recommendations. OMAF Pub. 360.
2. Guttridge, G. C. and H. M. Anderson. 1973. The relationship between plant size and fruitfulness in strawberry in Scotland. Hort. Res. 13:125-135.
3. Guttridge, G. C. and H. M. Anderson. 1981. Assessing fruit yield characteristics and potential in strawberry. Hort. Res. 21:83-98.
4. Jahn, O. L. and M. N. Dana. 1970. Effects of cultivar and plant age on vegetative growth of the strawberry, *Fragaria ananassa*. Amer. J. Bot. 57:993-999.
5. Nielson, B. V. and G. W. Eaton. 1983. Effects of boron nutrition upon strawberry yield components. HortScience 18:932-934.
6. Olsen, J. L., L. W. Martin, and P. J. Breen. 1985. Yield component analysis of 'Benton' and OR-US4356 strawberries. HortScience 20:74-76.
7. Schilletter, J. C. and H. W. Richey. 1931. Four year's study on the time of flower bud formation in Dunlap strawberry. Proc. Amer. Soc. Hort. Sci. 27:175-178.
8. Sproat, B. B., G. M. Darrow, and J. H. Beaumont. 1935. Relation of leaf area to berry production in the strawberry. Proc. Amer. Soc. Hort. Sci. 33:389-392.
9. Strik, B. C. 1985. Flower bud initiation in strawberry cultivars. Fruit Var. J. 39:5-9.
10. Strik, B. C. and J. T. A. Proctor. 1987a. Photosynthesis of strawberry and flower bud differentiation. J. Amer. Soc. Hort. Sci. (submitted).
11. Strik, B. C. and J. T. A. Proctor. 1987b. Yield component analysis of strawberry genotypes differing in productivity. J. Amer. Soc. Hort. Sci. (in press).
12. Webb, R. A., J. V. Purves, B. A. White, and R. Ellis. 1974. A critical path analysis of fruit production in strawberry. Scientia Hort. 2:175.-184.

Erratum

On page 141 the second sentence of materials and methods should read: Treatments consisted of the following combinations: 'Redhaven' on Lovell seedling rootstocks (RH/L), 'Redhaven' on Nemaguard seedling rootstock (RH/N), 'Redhaven' on *'Siberian C' seedling rootstock (RH/SC), 'Redhaven' own-rooted (RH-OR), 'Redhaven' on Lovell seedling rootstock with a 38 cm* 'Siberian C' interstem (RH/SC/L), 'Redhaven' on Nemaguard seedling rootstock with a 38 cm 'Siberian C' interstem (RH/SC/N), 'Siberian C' on Lovell seedling rootstock (SC/L), and 'Siberian C' on Nemaguard seedling rootstock (SC/N). All grafted tree combinations were propagated by T-budding. Own-rooted trees of 'Redhaven' were propagated from semi-hardwood cuttings. The underlined portions were omitted from *Fruit Varieties Journal* 41(4)140-41, 1987.

U. P. Hedrick Award Judges

The
American Pomological Society
extends sincere appreciation to

Dr. James Flore,
Michigan State University;

Dr. George M. Green,
Pennsylvania State University

and

Dr. Robert A. Norton,
Washington State University

for serving as judges for the
1987 U. P. Hedrick Awards.